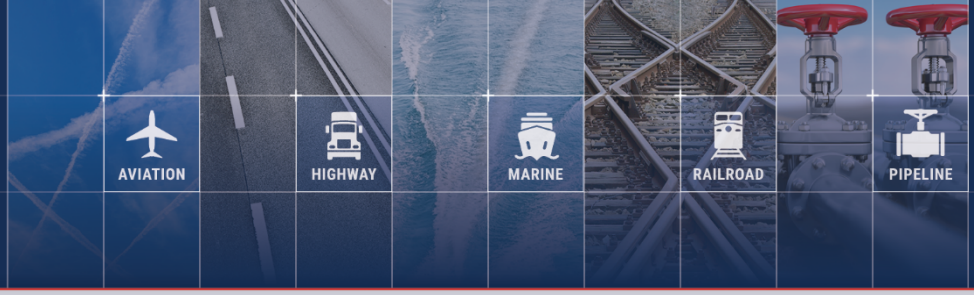

Aviation Investigation Final Report

Location:	Kaupo, Hawaii	**Accident Number:**	ANC23FA008
Date & Time:	December 15, 2022, 21:14 Local	**Registration:**	N13GZ
Aircraft:	RAYTHEON AIRCRAFT COMPANY C90A	**Aircraft Damage:**	Substantial
Defining Event:	Inflight upset	**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The medical transport flight was en route to pick up a patient on a neighboring island on an instrument flight rules (IFR) flight plan in dark night conditions over the ocean. About 13 minutes after departure, at 13,000 ft mean sea level (msl), the airplane's vertical gyro failed, which subsequently failed the pilot's Electric Attitude Director Indicator (EADI), which also caused the autopilot to disconnect. The failure of the EADI and autopilot disconnect required the pilot to manually fly the airplane using the copilot's attitude gyro for his horizon information (bank angle and pitch attitude) for the duration of the flight. The pilot did not declare an emergency, nor did he inform air traffic control (ATC) that his electric attitude indicator had failed and that his autopilot had disengaged.

After the instrumentation failure and autopilot disconnect, the airplane entered a series of right banks before being brought back to level, followed by a left turn, and then subsequent right banks. ATC asked the pilot to change course and the pilot agreed. The copilot attitude indicator indicated that the airplane entered a descending, steep right bank turn. Over the next 5 minutes, ATC issued varying instructions to the pilot. During this time, the airplane entered several right- and left-hand banks and rolls and descended 1,000 ft per minute (fpm), which increased to -3,500 fpm as the airplane's airspeed increased. About 7 minutes after the instrumentation failure, the airplane was in a 65° bank angle when ATC asked the pilot to verify his heading. As the pilot responded, the airplane bank angle increased to 90° and the airspeed exceeded 260 knots. The bank angle and airspeed continued to increase; a loud metallic bang was recorded that was consistent with an in-flight separation of the empennage from the fuselage before impacting with the water.

After an extensive underwater search, the main wreckage was located on the seabed at a depth of about 6,420 ft. The wreckage was recovered and transported to a facility for examination.

A postaccident examination of the engines and airframe revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation. The engines exhibited contact signatures consistent with the engines developing power at the time of impact.

The examination of the vertical gyro was unable to determine the reason for its failure due to the damage incurred by the unit during the accident sequence and the subsequent saltwater contamination.

The operator had installed an Appareo Vision 1000 airborne image recording system (AIRS) in the airplane in 2018. The camera was mounted in a position that captured the entire instrumentation for both the left and right seats, as well as the center pedestal and overhead panel.

During the accident flight, the Appareo video recording showed the pilot using his cell phone to listen to music shortly after takeoff, and the pilot talking to and passing money back to a medical flight crewmember as the airplane climbed through 1,400 ft msl. Both of these actions took place during a critical phase of flight and were in direct conflict with Guardian Flight's Standard Operating Procedures. The Appareo video recording revealed that the airplane's Collins multi-function display (MFD) was inoperative for the duration of the flight, and on the last four flights of recorded video. It also captured the EADI on the captain's side (or left side), going black, or inoperative, approximately 13 minutes into the flight. Additionally, the video recording captured audible sounds including the autopilot disconnect, master caution warning, altitude alert tones, and the sound of a loud metallic bang shortly before water impact.

Although this flight was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 flight, upon landing and loading the patient for transport to Honolulu the flight at that point would be operated under 14 *CFR* Part 135. Guardian Flight was allowed in their Operation Specifications to operate the Part 135 flight with a single pilot; however, those flights with only one pilot were required to have an operating autopilot. Therefore, in the airplane's condition, with the autopilot and EADI inoperative due to the vertical gyro failure, they would not have been able to transport the patient according to their Operation Specifications.

A review of the pilot's certification history before he was employed by Hawaii Life Flight revealed that he had six Notice of Disapproval entries in his Federal Aviation Administration (FAA) records. Of those six notices, three were in rotorcraft and three were in fixed-wing aircraft, each one the culmination of multiple unsatisfactory training events. The records detailed consistent deficiencies in the use of navigational systems, instruments, and multiengine aircraft maneuvering.

A review of the pilot's training record at Hawaii Life Flight indicated that during initial Advanced Aviation Training Devices (AATD) training, which consisted of 6 training sessions during

December 2019, he had five unsatisfactory ratings. Of those, two were on the last training event. The pilot was given two additional training sessions in January 2020 and all training areas indicated “satisfactory.”

The pilot had been employed by Hawaii Life Flight for three years and had six mandatory checking events. He failed three checkrides on the first attempt. Training records indicated that following each unsatisfactory training event, the accident pilot was given additional training, and subsequently reevaluated. The second evaluations were marked as “satisfactory.”

It is the responsibility of the operator to ensure their crews have the training, skills, competency, and proficiency to operate in their target environment. Guardian’s flight standards manual states that following multiple consecutive training or checking failures, the pilot should have been placed in remedial training and on an improvement plan. It was unclear if a formal plan was developed to address the issue. At no time did the pilot go to Guardian headquarters to facilitate retraining initiatives. Both the assistant chief pilot (ACP) and chief pilot (CP) stated the pilot was “retrained to proficiency.”

Guardian Flight was not required to have a flight operations quality assurance (FOQA) program. However, with the airplane equipped with a cockpit voice recorder (CVR), ADS-B, the Appareo cockpit imaging system, and the SkyTrac ISAT-100A satellite communication transceiver, they had the tools installed and in place to have a FOQA program. But Guardian Flight did not acquire the mechanism or means to manage or download the data from these systems. Guardian Flight’s failure to monitor operations likely contributed to this pilot’s non-compliance with the operating procedures. With a lack of appropriate infrastructure to monitor the flights, Guardian Flight did not have any way to determine this pilot’s nor any other pilot’s, compliance.

The pilot likely experienced spatial disorientation as result of the failed EADI and the autopilot disconnect. Spatial disorientation can affect even the most skilled pilots, but the phenomenon is more likely to occur with a pilot who has inexperience with or a history of deficiencies using navigational and instrument systems, such as exhibited by the accident pilot. Additionally, the pilot did not declare an emergency or communicate the loss of his attitude indicator or autopilot. Notifying ATC would have made them aware that they should limit communications to only what was necessary. Unaware of the issue, ATC continued to issue several instructions to which the pilot then tried to respond and adhere, diverting his attention away from manually flying the aircraft and maintaining spatial orientation. The loss of the EADI and autopilot disconnect in dark, overwater conditions, required the pilot to fly with a partial instrument panel and rely on the copilot’s attitude indicator, which likely resulted in the pilot’s spatial disorientation and loss of control. The pilot’s recurrent difficulties in aircraft maneuvering, systems management, and use of navigational instruments likely led to his inability to maintain positive control and spatial awareness once the EADI went inoperative and the autopilot ceased to function.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

Guardian Flight's inadequate pilot training and performance tracking, which failed to identify and correct the pilot's consistent lack of skill, and which resulted in the pilot's inability to maintain his position inflight using secondary instruments to navigate when the airplane's electronic attitude direction indicator failed, leading to his spatial disorientation and subsequent loss of control. Contributing to the accident was the lack of a visible horizon during dark night overwater conditions and the pilot's failure to declare an emergency with air traffic control.

Findings

Personnel issues	Aircraft control - Pilot
Personnel issues	Spatial disorientation - Pilot
Aircraft	Attitude gyro & indication - Failure
Aircraft	Autopilot system - Inoperative
Environmental issues	Dark - Effect on personnel
Organizational issues	Oversight of personnel - Operator
Personnel issues	Total experience w/ equipment - Pilot
Personnel issues	Total instruct/training recvd - Pilot
Organizational issues	(general) - Operator
Personnel issues	Use of policy/procedure - Pilot
Personnel issues	CRM/MRM techniques - Pilot

Factual Information

History of Flight

Enroute	Flight instrument malf/fail
Enroute	Sys/Comp malf/fail (non-power)
Enroute-cruise	Inflight upset (Defining event)
Enroute	Loss of control in flight

On December 15, 2022, about 2114 Hawaii-Aleutian standard time, a Raytheon Aircraft Company (formerly Beech) C90A, twin-engine, turbine-powered airplane, N13GZ, sustained substantial damage when it was involved in an accident near Kaupo, Hawaii. The airline transport pilot, flight paramedic, and flight nurse were fatally injured. The airplane was operated as a Title 14 *CFR* Part 91 air ambulance positioning flight.

The flight, operated by Guardian Flight LLC, dba Hawaii Life Flight, departed the Kahului Airport (OGG) on the Island of Maui, Hawaii, about 2053, on an instrument flight rules (IFR) flight plan. The accident airplane was destined for the Waimea-Kohala Airport (MUE), a 21-minute flight, on the Island of Hawaii to pick up a patient to be transported to Honolulu, Hawaii.

A review of the Appareo Vision 1000 recorded images and audio data, archived voice communication information, and ADS-Bdata revealed that the pilot engaged the autopilot shortly after takeoff at about 160 ft msl. He retracted the landing gear about 700 ft above ground level and reduced propeller pitch. After departure from OGG about 2055, the pilot contacted the departure ATC specialist on duty, indicating the flight was at 1,000 ft msl climbing to 11,000 ft msl.

After the airplane departed OGG, it initially proceeded north, then it turned eastbound, which is consistent with the Onohi Two standard instrument departure procedure.

As the airplane climbed through 1,400 ft msl, the pilot passed money to a medical flight crewmember seated in the cabin.

About 2056, the pilot opened a music app on his cell phone and set it down in the right seat as the airplane climbed through 4,500 ft msl. The pilot looked at an approach plate on the iPad and entered approach frequencies.

About 2100, as the airplane climbed through 8,000 ft msl, the pilot repeatedly manipulated the buttons on the Collins MFD, but the screen remained blank and unresponsive. Review of previous flights revealed the Collins MFD was not working in the last four flights of recorded video. According to the Daily Maintenance Records there were no entries for the MFD being inoperative in the two weeks prior to the accident.

About 2102, the departure ATC specialist instructed the pilot to contact Honolulu Air Route Traffic Control Center (ARTCC).

About 2103, the pilot contacted the ARTCC specialist on duty and reported level at 11,000 ft msl, and the pilot requested the RNAV 4 instrument approach at MUE.

About 2104, the ARTCC specialist asked if the pilot could climb to 13,000 ft msl, and the pilot responded that he could.

The flight proceeded on an east-southeasterly heading and along the northern shoreline of the Island of Maui, and then it turned southbound along the predetermined flight route.

About 2106, the autopilot disconnect alert tone sounded, and the autopilot disconnect light illuminated. The pilot's Electric Attitude Director Indicator (EADI) did not display artificial horizon information for the duration of the flight, red warnings flashed several times, and then remained lit (see Figure 1). The flight nurse asked the pilot if the autopilot had disconnected, and the pilot confirmed to the flight nurse that it had.

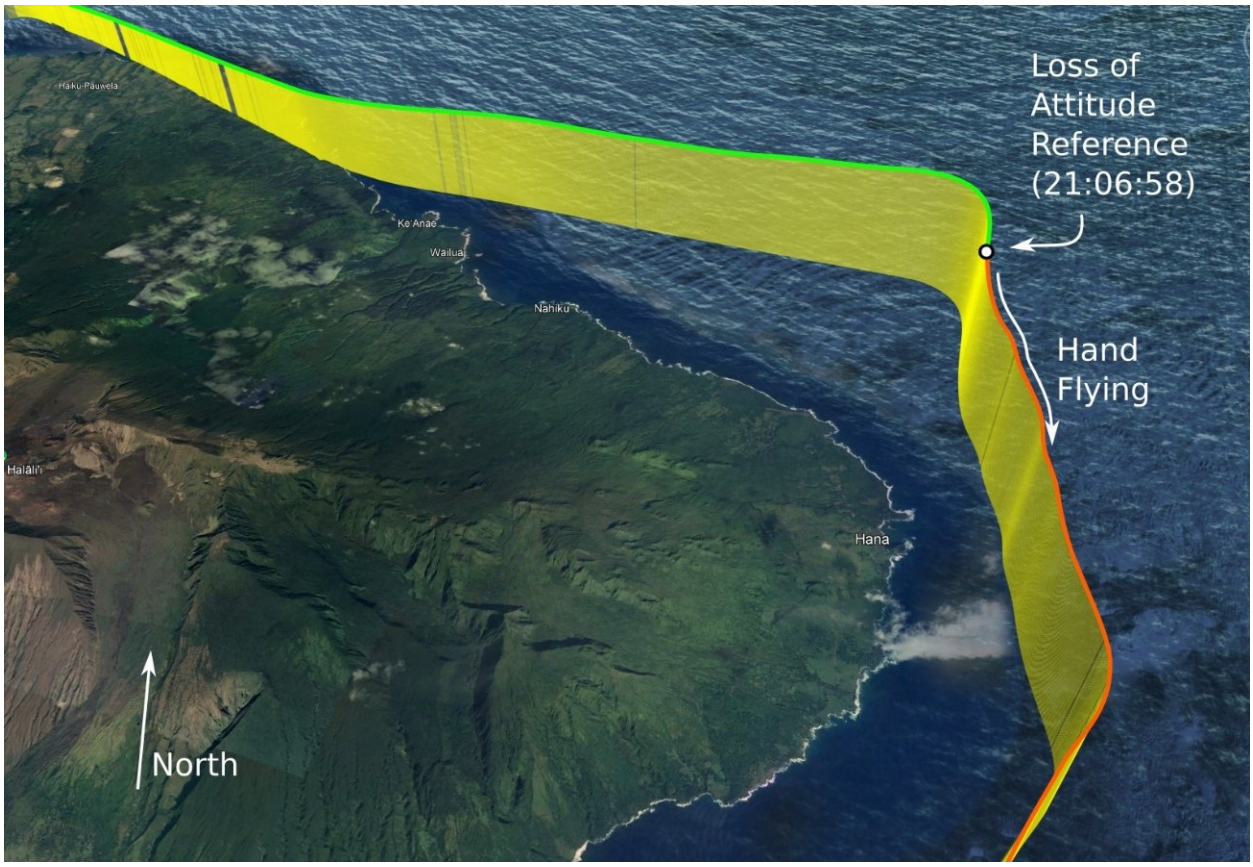

Figure 1. Google Earth image of portion of the flight path.

About 2107, the copilot side attitude indicator indicated a 30° bank angle to the right and then returned to level flight. The altimeter alert sounded, and the altimeter read 13,220 ft. The pilot adjusted the pitch trim, and the attitude indicator indicated a steepening right bank, and then a left turn.

About 2108, as the flight continued on a southeasterly heading, the ARTCC specialist initially instructed the pilot to turn right to a heading of 180°, and then to an amended heading of 200°; the pilot acknowledged the 200° heading. The attitude indicator indicated a descending and deepening right bank turn.

About 2109, as the flight continued on a 200° heading at 13,000 ft msl, the ARTCC specialist instructed the pilot to descend to 12,000 ft msl, and the pilot accepted.

About 2110, the ARTCC specialist instructed the pilot to descend to 8,000 ft msl, and the pilot acknowledged.

About 2111, ATC issued a traffic advisory and the airplane leveled off and began a left turn. Immediately following the pilot's response to the traffic advisory, the airplane began an increasingly rapid descent through 12,000 ft msl and leveled off at 11,120 ft msl.

About 2112, the ARTCC specialist instructed the pilot to fly a heading of 180°, and he cleared the flight to fly direct to TAMMI, the initial approach fix for the RNAV (GPS) 4 approach to MUE, and the pilot acknowledged the instructions. The airplane was in a slight left, descending turn. The pilot manipulated the GPS and selected direct TAMMI. The attitude indicator indicated an increasing right bank, and the airplane was descending at 1,000 ft per minute. The airplane continued to descend through 10,180 ft msl, and the rate of descent increased as the roll increased to 65° angle of bank to the right.

At 2113:22, the ARTCC specialist contacted the pilot of N13GZ, asking him to verify that he was flying "direct to Tammi" as previously instructed.

At 2113:40, the pilot replied: "Uhh, 13GZ is off navigation here… we're gonna… we're gonna give it a try." The vertical speed indicator was pegged at -3,500 fpm (see Figure 2).

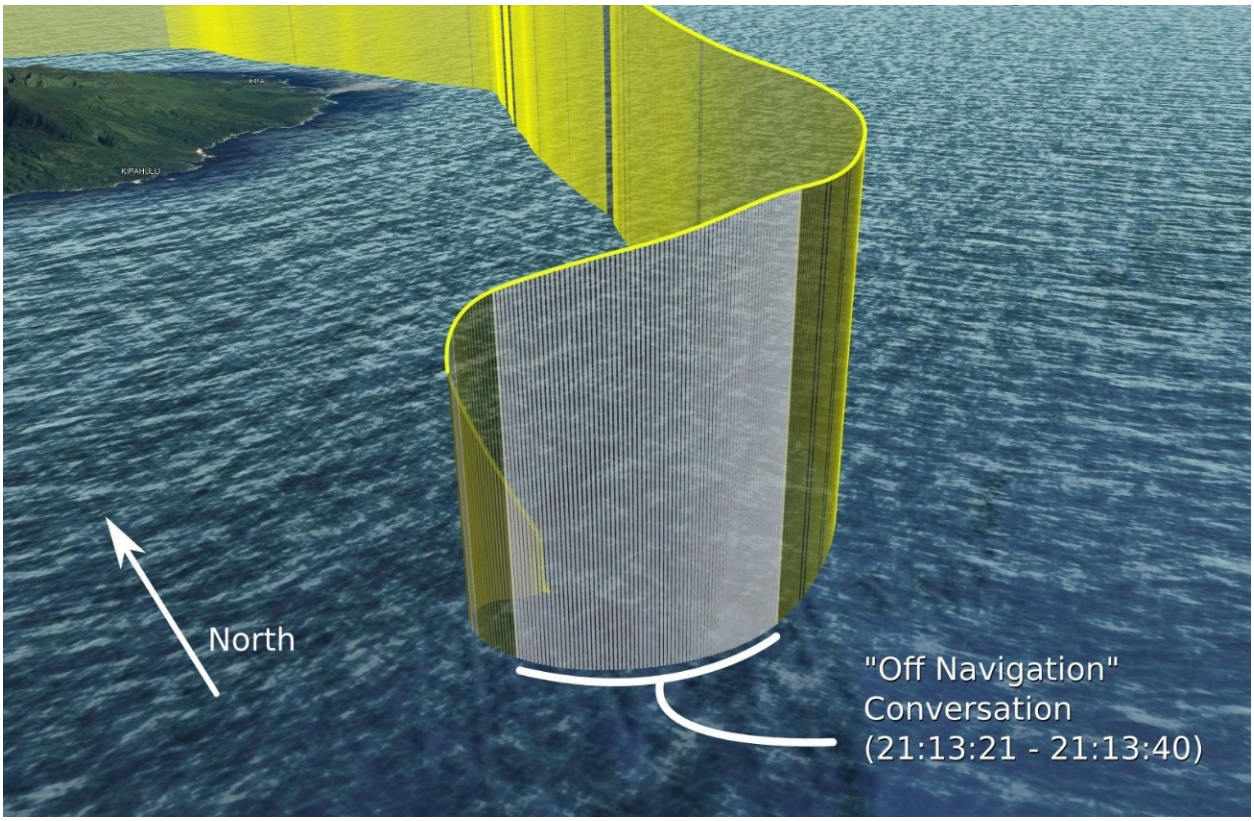

Figure 2. Google Earth image of a portion of the flight track.

At 2113:32, the ARTCC specialist acknowledged the pilot's last statement and instructed him to turn right to a 170° heading and to maintain 8,000 ft msl. The copilot attitude indicator displayed 90° angle of bank. The airspeed indicator needle was at the maximum operating speed of 226 knots.

At 21:13:41 the attitude indicator showed an inverted descending right turn.

At 2113:43, as the airplane passed through 7,700 ft msl, a final radio transmission, believed to be from the accident pilot, is heard saying "Hang on." The altimeter was showing a very rapid descent. The engine gauges were within normal range.

At 21:13:51, the airplane passed through 4,000 ft msl and was rapidly decreasing. The yoke seemed to move quickly forward and then aft in a jolt like manner. As the movement towards the aft position of the yoke occurred, a sound similar to a loud metallic bang was audible. The camera recorded a rapid jolt, and the field of view of the recorded image noticeably changed. The control panel illumination appeared to be extinguished, consistent with the airplane main power bus failing, and switching over to battery power.

The last recorded frame of the video and end of audio recording at 21:14:06 showed the altimeter indicating about 400 ft msl.

There were no further communications with the accident flight. The pilot did not declare an emergency, report the instrumentation failure, or report that the autopilot was disengaged. The

ADS-B data stopped about 10 miles south of Kaupo, near where a witness observed the accident airplane impact the water. (Figure 3)

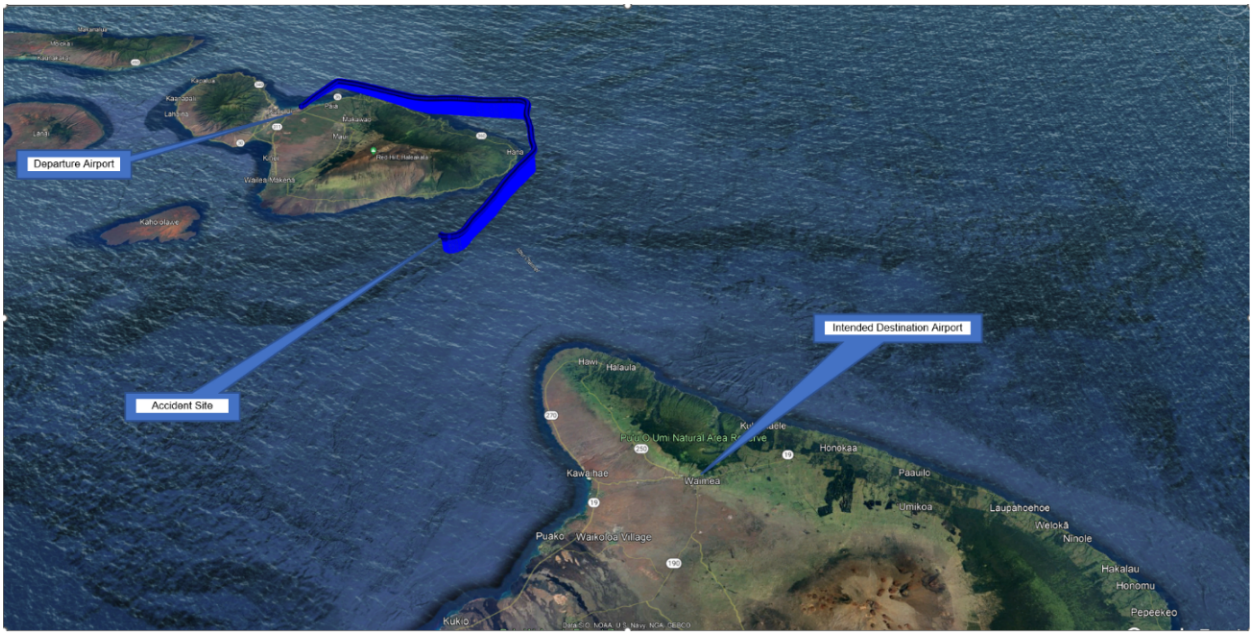

Figure 3. Google Earth image of the flight path from the departure airport, and depecting the destination airport.

A witness, who was flying a low-wing Piper PA-44 airplane from Hilo, Hawaii, to Honolulu, reported seeing the accident airplane well above and to the north of his flight path. The ARTCC specialist reported that N13GZ was at the PA-44 pilot's 3 o'clock position at 12,000 ft msl, descending to 8,000 ft msl. The witness continued watching the lights of the airplane and said that as the airplane continued southbound it began a right turn. Then it entered a spiraling right descending turn, which steepened as the descent increased. The airplane continued to descend until it impacted the surface of the water. He lost sight of the airplane's lights shortly after the airplane impacted the water. The red flight track represents the accident airplane, and the yellow flight track represents the eyewitness airplane (see Figure 4).

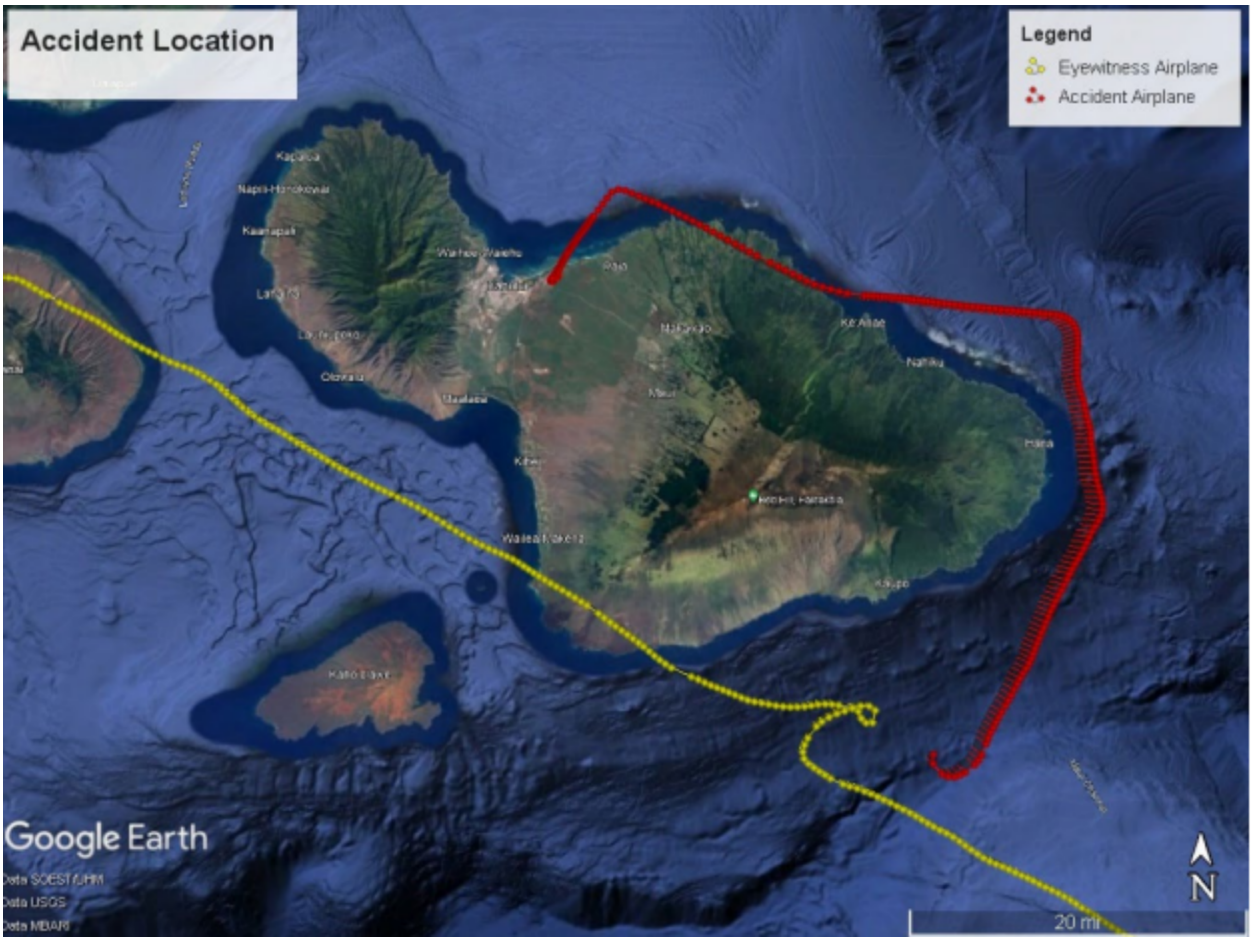

Figure 4. Google Earth image of the accident flight path and the witness's airplane flight path.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	47,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	April 21, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 21, 2022
Flight Time:	7668 hours (Total, all aircraft), 615 hours (Total, this make and model), 7138 hours (Pilot In Command, all aircraft), 65 hours (Last 90 days, all aircraft), 32 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Passenger Information

Certificate:		**Age:**	Female
Airplane Rating(s):		**Seat Occupied:**	Unknown
Other Aircraft Rating(s):		**Restraint Used:**	Unknown
Instrument Rating(s):		**Second Pilot Present:**	No
Instructor Rating(s):		**Toxicology Performed:**	
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

Passenger Information

Certificate:		**Age:**	Male
Airplane Rating(s):		**Seat Occupied:**	Unknown
Other Aircraft Rating(s):		**Restraint Used:**	Unknown
Instrument Rating(s):		**Second Pilot Present:**	No
Instructor Rating(s):		**Toxicology Performed:**	
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

The pilot held an Airline Transport Pilot (ATP) certificate with a rating for multiengine land and Rotorcraft-helicopter, with commercial pilot privileges for airplane single-engine land and airplane single-engine sea, and type ratings on the B-737, EMB-145, and LR-60. The pilot's ratings included limitation of B-737, EMB145 Circling approach – VMC only, EMB-145 is

subject to pilot-in-command limitation(s), LR-60 SIC privileges only, and English proficient. He held a flight instructor certificate with ratings for rotorcraft-helicopter and instrument helicopter, and a remote pilot certificate with a rating for small, unmanned aircraft system. He held an FAA second-class medical certificate dated April 21, 2022, with limitation of must have available glasses for near vision. At the time of the accident, he was based at OGG.

When he was hired by Hawaii Life Flight on December 2, 2019, he had 7,668 total hours of flight time, about 950 of which were in fixed-wing airplanes. Before being hired at Guardian Flight, from 2009 to 2019, pilot had six Notice of Disapproval entries on his certification records: three for rotorcraft and three for fixed-wing — each one the culmination of multiple unsatisfactory training events. Of the three fixed-wing notices, two were issued when the applicant was applying for an ATP multiengine land airplane certificate. The third and most recent notice of disapproval was when the applicant was applying for an additional type rating to his ATP certificate. A review of the unsatisfactory items in the three most recent notices of disapproval indicated, in part: “poor automation management especially as to the FMS and lateral nav[igation] situational awareness;” “applicant did not demonstrate proper recovery for clean stall;” and various other reasons including, but not limited to, airplane performance procedures. The records detailed consistent deficiencies in use of navigational systems, instruments, and multiengine aircraft maneuvering.

The pilot’s schedule consisted of a two-weeks-on, two-weeks-off rotational cycle where the pilot was on call at his personal residence for a 12-hour period. The shifts would alternate between day shift (0500 – 1700) for the first week and night shift (1700 - 0500) for the second. The pilot was working his second week at the time of the accident.On December 14, the pilot moved to the night shift and received a call out in the morning of December 15. He was actively flying from approximately 0400 to 0630. The pilot then went off shift and returned to his personal residence. According to his next of kin, the pilot was active in the morning, had lunch and was active again in the afternoon. They had dinner together and were ready to retire for the evening about 1930 when he later received the call out for what resulted in the accident flight.

Training

A review of the pilot’s training record indicated that during initial Advanced Aviation Training Devices (AATD) training, which consisted of 6 training sessions during December 2019, the pilot had five unsatisfactory ratings. Of those, two were on the last training event. The pilot was given two additional training sessions in January 2020 and all training areas indicated satisfactory.

The pilot had been employed by Hawaii Life Flight for three years and had conducted three 6-month pilot proficiency checks and three annual recurrent 135.293, 135.297, and 135.299 proficiency checks. He failed three checkrides, or half of those events, on the first attempt. Records indicated that the pilot’s recurrent 135.293, 135.297, and 135.299 proficiency check on February 2021 was unsatisfactory. The flight maneuvers that were graded unsatisfactory

were "*Landing with simulated powerplant failure."* According to the assistant chief pilot (ACP) of Hawaii Life Flight, he had conducted some of the accident pilot's checkrides. The ACP recalled that in July of 2020 the accident pilot unsatisfactorily completed two maneuvers. "*The first one was an unsatisfactory non-precision RNAV three approach. Failure to follow correct approach procedure. Descent below authorized altitude before the final approach fix. And then I put satisfactory on the next non-precision approach, correct altitude procedure on the next approach. His second …maneuver that was unsatisfactory. Landing from a circle approach, bank angle exceeded 30 degrees from base to final. Satisfactory on the next landing from circle approach. And then that was a satisfactory check."*

The ACP conducted a second checkride with him about a year later; that checkride was marked as "*unsatisfactory."* According to the ACP, "*it was a missed approach. Unsatisfactory missed approach. Failure to stop climb at authorized given altitude. The second unsatisfactory I put in there was ILS power plant failure. Improper airplane configuration before DA or DH. Yeah, I remember he went full flaps before that that. He put full flaps after the final approach fix…and a third one was again on the second missed approach failure to ensure proper airplane configuration during missed approach. So, we were at miss on that one and he didn't clean the airplane up. We were, we were already headed out with the hold and the gear was still down and everything was still configured for landing."* The ACP provided the accident pilot with his recheck event, which was "satisfactory."

After the accident, the Director of Operations (DO) at Guardian Flight, LLC reviewed the pilot's training records and said there were some concerns, and it wasn't "*what* [he] *would consider a normal training record*." The DO said he believed there was "*missed communication*" between Hawaii Life Flight's ACP and the Chief Pilot (CP) on how the accident pilot was performing. The DO said he believed there was a drive for Hawaii Life Flight leadership to take care of performance or intrapersonal issues autonomously rather than involve others at the Guardian Flight level.

When asked about the accident pilot, the CP stated he had reviewed the accident pilot's records and noted there were some deficiencies in training listed on the PRIA and that the pilot had "*a lot of helicopter hours and the fixed wing hours were low.*" The CP said the accident pilot's two previous jobs were flying fixed-wing aircraft professionally; that information combined with his interview and AATD performance made the pilot a candidate to consider.

The ACP was responsible for reviewing pilots' applications for Hawaii Life Flight and did so for the accident pilot's application, although he said the final approval had to come from the chief pilot. Human resources at Guardian Flight was responsible for clearing the applicant's work history and for drafting the offer letter. The ACP could not remember any specifics about the accident pilot's hiring process but did remember he was referred to the company by another line pilot. When asked what he looked for in an applicant, the ACP said he would make inquires with the applicant's previous employer and consider their overall experience and performance in the AATD.

The Director of Training (DT) stated that he conducted a records review postaccident and noted there were "multiple unsatisfactory remarks, repeat unsatisfactory remarks on similar or same tasks, [and] failed check rides" and that he was not made aware of the pilot's performance. The exception was when the pilot was hired initially as the DT was part of an additional panel convened to assess the pilot's past training deficiencies denoted in his Pilot's Record Database (PRD) record. A performance and training plan was created, which the accident pilot successfully completed. The DT stated, "…if there is an individual that is demonstrating weakness throughout simulator AATD training, they should be given training to bring that individual to satisfactory standards." He also said that any pilot not meeting the standard should be brought to the attention of the CP, the DO, and the DT.

Guardian's flight standards manual states that, following multiple consecutive training or checking failures, a pilot was to have been placed in remedial training and on an improvement plan that would be coordinated by the ACP and the CP. While the CP did say he had conversations and exchanged emails with the ACP and the DT about retraining the accident pilot, it was unclear if a formal plan was developed to address the issue. At no time did the pilot go to Guardian headquarters to facilitate retraining initiatives. Both the ACP and CP stated the pilot was "retrained to proficiency." The Director of Safety stated Guardian had an Aviation Safety Action Program (ASAP) with an event review committee consisting of an FAA representative and employee nominated flight operations and maintenance representatives. Central to Guardian's safety program was their Baldwin reporting system. The system was the main repository for pilot reported discrepancies, flight risk assessments and anonymous reporting. The flight risk assessment produced a numerical value, which then determined whether a flight was to proceed as designed, or if it required higher level assessment, or if the flight was considered too high a risk to proceed. That information would then be given to the communication specialist for tracking and archival purposes. With a score of 1 or 2 the flight could proceed. With a score of 3 or 4, or if a specific criterion was met independent of the aggregate score, the crew was required to contact the pilot manager on call (PMOC) to help mitigate the risks. A score of 5 immediately disqualified the flight. The accident flight risk assessment score was a "2" (on a scale of 1-5), indicating the flight was able to proceed as planned.

Other Flying

At the time of the accident, the pilot was also flying for a local sightseeing helicopter operator. According to that operator's pilot duty log, the accident pilot's most recent activity with them occurred on December 5, 2022, ten days before the accident, which indicated 0.9 hours of flight time in the EC130 helicopter. Before that flight, the only other flight in December for Sunshine Helicopters was on December 3, 2022, in which the accident pilot flew 2.7 hours. A further review of the accident pilot's training records since October 2022 indicated that he had flown an EC130 and an AS350 helicopter for a total of 38 total hours of flight experience.

Found within his personal effects at the accident site was a handwritten note addressed to the pilot. It advised he should not be "forced to fly through the clouds by any person in the back"

[of the airplane]. It was confirmed the author of the letter was the pilot's next-of-kin and was written in March of that same year. The pilot's cell phone and a company iPad were also found within the wreckage. Video documentation latershowed that the pilot used his cell phone to play music while in flight and the iPad to access GPS map imagery. Due to saltwater corrosion no data was recovered from the iPhone or iPad.

Aircraft and Owner/Operator Information

Aircraft Make:	RAYTHEON AIRCRAFT COMPANY	**Registration:**	N13GZ
Model/Series:	C90A NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	2000	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	LJ-1590
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	August 30, 2022 AAIP	**Certified Max Gross Wt.:**	10485 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	10130 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney
ELT:	Installed	**Engine Model/Series:**	PT6A-21
Registered Owner:	GUARDIAN FLIGHT LLC	**Rated Power:**	500 Horsepower
Operator:	GUARDIAN FLIGHT LLC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	Hawaii Life Flight	**Operator Designator Code:**	

The Raytheon Aircraft Company C90A was manufactured in 2000. It was powered by two Pratt & Whitney Canada PT6A-21 engines. The aircraft was purchased by Guardian Flight LLC in September 2017 from Guardian Flight Inc.

The aircraft was configured with two flight crew seats in the cockpit. The patient stretcher systems were installed on the right side of the cabin portion of the airplane, along with one passenger seat, and three passenger seats were on the left side of the cabin portion of the airplane (see Figure 5).

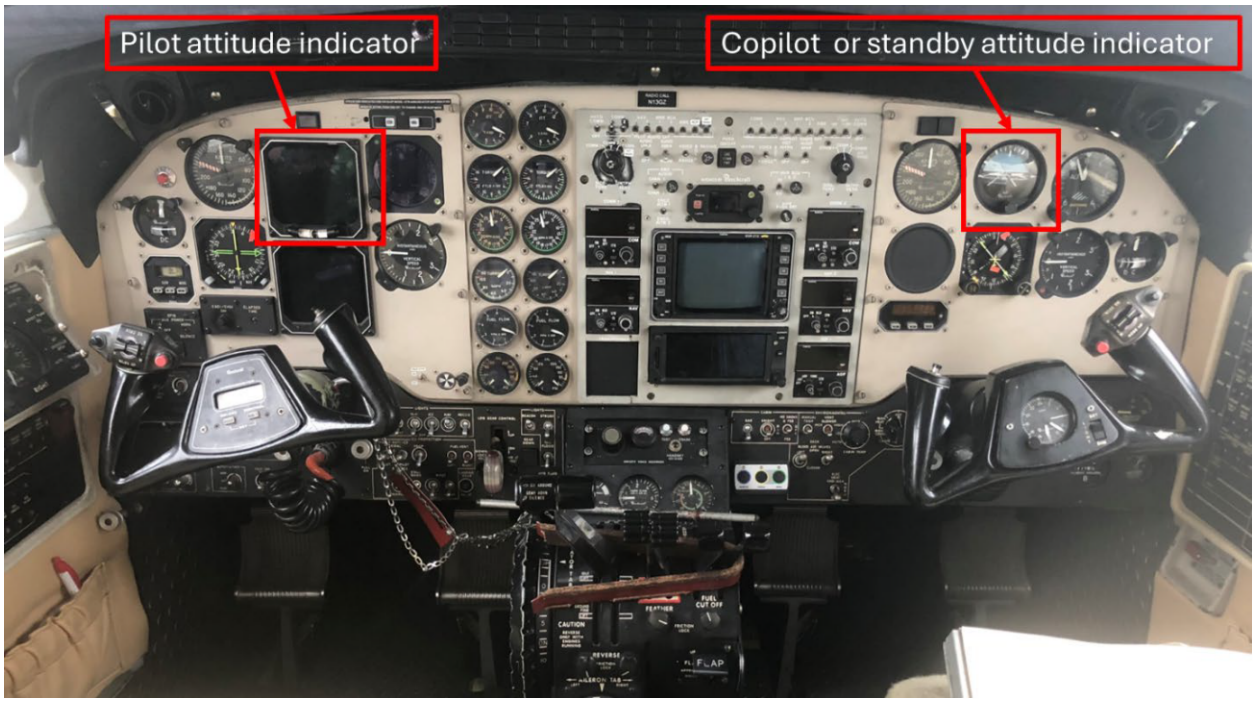

Figure 5. Illustrated instrument panel of the pilot attitude indicator and copilot or standby attitude indicator.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	HOG,46 ft msl	**Distance from Accident Site:**	28 Nautical Miles
Observation Time:	20:54 Local	**Direction from Accident Site:**	314°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.89 inches Hg	**Temperature/Dew Point:**	22°C / 18°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Kahului, HI (OGG)	**Type of Flight Plan Filed:**	IFR
Destination:	Waimea-Kohala, HI (MUE)	**Type of Clearance:**	IFR
Departure Time:	20:53 Local	**Type of Airspace:**	Class E

At the time of the accident the moon was approximately 38° below the horizon and was due to rise at midnight local time. Dark night conditions prevailed at the time of the accident.

According to the preflight planning report, the departure, route, and destination were all VFR with a reported 10 miles visibility, and the lowest reported clouds were at 7,500 ft, which was at the destination airport.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	Unknown
Ground Injuries:		**Aircraft Explosion:**	Unknown
Total Injuries:	3 Fatal	**Latitude, Longitude:**	20.558293,-156.07067

The airplane impacted the ocean off the coast of Maui and sank to a depth of about 6,420 ft. The wreckage was recovered from the ocean on January 10, 2023, and was transported to a secure facility in Honolulu, Hawaii, for examination.

The postaccident examination revealed that the wreckage displayed vertical crush damage consistent with impact at a high rate of descent. The fuselage, from the nose to tail section, was impact damaged and compressed upward. The empennage separated from the fuselage in flight and was not recovered. The left and right wings were mostly intact but damaged from the wing roots out to beyond the end of the outboard flaps; neither wing tip was recovered. The lower surface of the wings had significant upward hydraulic compression damage. All wing separations exhibited signatures consistent with tension overload.

Control cable continuity was established from the left and right wing bellcranks to the fuselage and the cockpit. The elevator cable continuity was verified from the aft bellcrank to the cockpit. The continuity of one rudder cable was verified from the tail section to the cockpit. The second rudder cable was not located. The flap actuators indicated that the flaps were in the UP position. The flap handle was found in the UP position. The landing gear handle was found in the DOWN position.

The artificial horizon was uncaged and banked right and nose high, greater than 45°. The attitude gyro was disassembled; scoring was present on the inside of the gyro housing.

The accident examination of the engines revealed that the engines displayed contact signatures to their internal components characteristic of the engines developing power at the time of impact. The examination of the engines revealed no evidence of mechanical

malfunctions or failures that would have precluded normal operation. No anomalies, contamination, or evidence of malfunction were found in any of the engine accessories.

Vertical Gyro

The Appareo Vision 1000 cockpit video recording of the accident indicated that the autopilot and the attitude indicator failed at the same time. The only component common to both systems is the vertical gyro.The vertical reference gyro provides 3-wire synchro pitch and roll attitude data to the autopilot and to the attitude indicator.

The vertical gyro was manufactured in May 1992. The unit was overhauled by Precision Accessories and Instruments (PAI) and shipped out in August 2022. The rotor and gimbal bearings, gasket, decals, and a capacitor were replaced. The vertical gyro was installed on the aircraft in August 2022.

A postaccident examination of the vertical gyro was performed. The unit was crushed inward on the top and 2 sides (see Figure 6).

Figure 6. View of inward crushing on the vertical gyro housing.

The crushing of the case is consistent with excessive external water pressure. There were salt deposits on the electrical connector. The airframe electrical connector was removed. The pins were straight. The sockets on the aircraft side of the connector were present and none

appeared to be recessed.The preservation sealing tape around the base of the unit was removed. Water was present and was drained from the unit. The cover was removed. The interior of the unit was covered in marine growth and deposits. The unit was washed with de-ionized water and some of the marine growth was removed (see Figure 7).

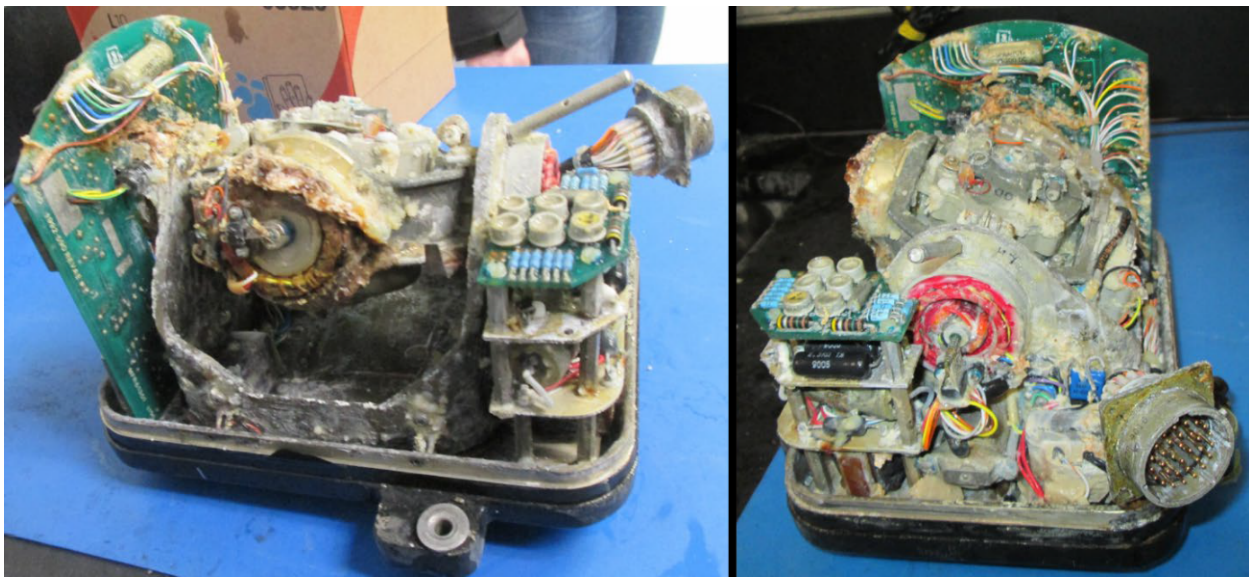

Figure 7. Corrosion and marine growth inside the vertical gyro.

The slip ring was damaged, and the damage appeared to correspond to the crushed cover. Several components on the unit were observed to be crushed. The S1 switch was broken, and the damage appears to correspond to the crushed cover. Damage to wire wound resistor (R61) on terminal board 7 (TB7) was observed. The resistance across the resistor was measured at 83.5 ohms as found. One of the wires between the resistor and the board was cut to isolate the resistor. The resistance across the resistor was re-measured at 83.4 ohms. (Note that the R61 resistor has a nominal value of 82 ohms.)

The motor/spinning mass casing was observed to be normal in color. (If the motor seizes, the motor/spinning mass casing becomes discolored due to overheating.)

Continuity checks were performed on the electrical connector of the unit. Operation of the unit was not possible due to deposits on the unit. The area where the R61 resistor was located showed some corrosion deposits but no thermal damage. No other anomalies were observed during the examination.

Automatic Autopilot Disengagement

The Beechcraft King Air C90B Pilot's Operating Handbooks and FAA Approved Airplane Flight Manual Supplement for the Collins FCS-65H Automatic Flight Control System with Collins EFIS-84 (2-Tube System with Single Date Processor Unit) Electronic Flight Instrument System, provided the following information concerning the automatic autopilot disengagement and attitude failure:

The following conditions will cause the autopilot to automatically disengage. Disengagement will normally be accompanied by the aural warning.

1. Electrical Power…….MAJOR DEGRADATION, INTERRUPTION, OR LOSS
2. Vertical Gyro (ATT Flag on EADI)……...FAILURE
3. Roll Attitude…….……More than 50°
4. Pitch Attitude……GREATER THAN ±40
5. A/P FAIL Annunciator…….……ILLUMINATED

ATTITUDE FAILURE

Attitude failure is indicated by a red ATT flag on the EADI.

- Use copilot's attitude indicator.

NOTE

The autopilot will disengage if it is selected ON.

Flight recorders

The accident airplane was equipped with a Fairchild/L3 A-100S CVR installed in the aft fuselage that recorded 30 minutes of audio recording. The CVR was equipped with a Dukane acoustic underwater locator beacon (ULB or pinger) to help locate it, with a required battery life of 30 days. The ULB would ping at a frequency of 37.5 kHz about once a second when submerged.The audio was successfully downloaded by the National Transportation Safety Board (NTSB) Recorders Laboratory. The downloaded recording contained communication between the pilot and air traffic control as well as ambient noises from with the airplane.

The operator had installed a SkyTrac ISAT-100A satellite communication transceiver to provide automatic, real-time flight following. The water pressure at the depth the wreckage was recovered is approximately 2,600 pounds per square inch (psi). The unit’s memory device, a microSD card, was found cracked and the data was unrecoverable. The device is not designed, nor is it required to survive sea water immersion or meet any kind of survivability standard.

The operator had installed an Appareo Vision 1000 airborne image recording system on the cockpit ceiling to record video of the cockpit during flight. FAA records show that it was installed in December 2018. The device was sent to the NTSB Vehicle Recorders Laboratory

for examination and download. The Appareo Vision 1000 records about the two hours of image, audio, and parametric data, and is equipped with an internal memory module. The camera was mounted in a position that captured the entire instrumentation for both the left seat and right seat, as well as the center pedestal and overhead panel (see Figure 8). During the accident flight, the Appareo video recording captured, in part: the pilot utilizing a cell phone to listen to music after takeoff; the Collins MFD being inoperative for the duration of the flight; and the Electronic Flight Instrument System, which included the EADI on the captain's side (or left side), going black or inoperative approximately 13 minutes into the flight (see Figure 9). Additionally, the Appareo system captured audible sounds including the autopilot disconnect, master caution, altitude alert tones, and the sound of a loud metallic bang.

Figure 8. Appareo image of accident flight.

Figure 9. Appareo image of the Electronic Attitude Director Indicator, before and after the failure.

Medical and Pathological Information

The Department of the Medical Examiner, City and County of Honolulu, performed the autopsy of the pilot. According to the autopsy report, the pilot's cause of death was multiple blunt force injuries, and the manner of death was accident. No significant natural disease was identified. The FAA Forensic Sciences Laboratory performed toxicological testing of the postmortem tissue of the pilot; it was negative for drugs and alcohol.

Organizational and Management Information

The operator, Guardian Flight, LLC, based in South Jordan, Utah, was a 14 *CFR* Part 135 operator that held on-demand operations specifications. It was part of the Global Medical Response Solution company, which included Hawaii Life Flight. Hawaii Life Flight had been providing air medical transportation in Hawaii since 2010 and consisted of six bases. At the time of the accident, the president, director of operations, chief pilot, and director of maintenance all were based in South Jordan, Utah. The company was operating about 71 airplanes, of which 31 were Raytheon Aircraft Company C90As.

Although the accident flight was operated under Title 14 *CFR* Part 91, upon landing and loading the patient for transport to Honolulu, the flight would then be operated under 14 *CFR* Part 135. Guardian Flight was allowed in their Operation Specifications to operate the Part 135 flight with a single pilot; however, flights with only one pilot were required to have an operating autopilot.

The accident airplane was equipped with an Appareo Vision 1000 video recording system, which is a flight data recorder that can provide performance and safety data, typically via an SD card. According to interviews with Guardian Flight LLC and Hawaii Life Flight personnel, the Appareo was installed with the intent of being part of their flight operational quality assurance (FOQA) program; however, at the time of the accident, the FOQA program had not been brought to fruition.

Guardian Flight Standard Operating Procedures and Manuals

PIC duties

Guardian Flight's General Operations Manual, section 2.15 "*Pilot in Command"* provided the following:

3. *ALWAYS operates the aircraft in a safe, comfortable and efficient manner.*

Fight Deck Discipline

The Guardian Flight C90 Standard Operating Procedure, Revision #3, dated 04/18/2019 provided the following policy in regard to flight deck discipline:

> ***Sterile cockpit:***
>
> *1) Guardian Flight defines "critical phase of flight" as any time the engines are running on the ground, the aircraft is moving on the ground, take-off, landing and flight below 10,000 feet excluding cruise.*
> *2) Guardian Flight shall not require, nor may any flight crewmember perform any duties during a critical phase of flight except those duties required for the safe operation of the aircraft.*
> *3) No flight crewmember may engage in, nor may any PIC permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance*

of his or her duties or which could interfere in any way with the proper conduct of those duties.

4) *It is the responsibly of the PIC to brief medical team members on the definition of a sterile cockpit and the associated procedures if they appear to be unfamiliar with this policy.*

Use of music players:

1) Shall not be used during any critical phase of flight.

2) Shall not be used at a volume that would interfere with ATC communications.

Multiple Consecutive Training/Checking Failures

The Guardian Flight, Flight Standards Manual Chapter 3 "*Administration,"* provided the following in regard to multiple consecutive training or checking failures:

> *If a pilot fails a training or checking event on two successive attempts then the pilot will either be placed into a comprehensive retraining process or employment may be terminated. This comprehensive retrain process may consist of the following:*
>
> 1. *Being placed into an initial/recurrent/remedial training class for a final attempt to complete the required training*
> 2. *Conducting a final evaluation to determine future training and checking requirements. Pilot Improvement plan as directed by the Chief Pilot and ACP.*

The FAA Principal Operations Inspector (POI) and Frontline Manager (FLM), based in Salt Lake City, Utah, were interviewed regarding their oversight of Guardian Flight. Both the POI and the Guardian DO reported a good working relationship, they met monthly and felt there was open communication. The POI stated her workload was high, but she was able to do line checks with the check airmen. Because Guardian Flight has bases across the country other FAA offices provided oversight for the other bases, as requested by the POI. The FLM stated each operator is rated on a point scale based on complexity and size. The POI was at the maximum number of points for her paygrade.

The Hawaii Life Flight ACP stated the FAA would visit their facility for maintenance inspections two to three times a year. He stated that a Honolulu inspector would conduct biennial checkrides with the line check airmen.

Additional Information

"Fly Safe: Prevent Loss of Control Accidents"

On July 26, 2018, the FAA issued a press release titled "*Fly Safe: Prevent Loss of Control Accidents."* The following guidance, in part, was provided to all readers as part of the FAA's "*Fly Safe"* campaign:

> *A Loss of Control (LOC) accident involves an unintended departure of an aircraft from controlled flight. LOC can happen when the aircraft enters a flight regime that is outside its normal flight envelope and quickly develops into a stall or spin. It can introduce an element of surprise for the pilot.*
>
> ***What does it Mean to "Fly the Aircraft First?"***
>
> *Eliminate distraction. How often have we heard that phrase when it comes to operating dangerous or heavy equipment, especially driving a car? How tempting is it to pay less attention to your aircraft and more attention to an air traffic control (ATC) transmission, app, or conversation while in the cockpit?*
>
> *NTSB data suggests that distraction is a significant cause of accidents. These accidents can be avoided. We remind you to maintain aircraft control at all times. This might mean a short delay in responding to ATC communications or passenger requests. In other words, Fly the Aircraft First!!*
>
> ***Aviate, Navigate, Communicate***
>
> *Do you remember that lesson from your first days in pilot ground school? Aviate, Navigate, Communicate. Three top priorities, but the leader of them all is Aviate. That means to fly the airplane by using the flight controls and flight instruments to direct the airplane's attitude, airspeed, and altitude. The instruments directly in front of you provide important information about your control of the aircraft. They give you critical information about airspeed, attitude, altitude, vertical speed and rate, magnetic heading, and turns and coordination.*
>
> *Rounding out the top three is Navigate (figuring out where you are and where you're going) and Communicate (talking with ATC or someone outside the cockpit). It seems very simple, but it's easy to forget when you become distracted.*
>
> ***Disconnect from Distraction***
>
> *This example demonstrates how deadly distractions can be. Do all that you can to minimize distractions from every source. Explain sterile cockpit procedures to your passengers. Self-brief if you are alone. Establish the focused, no-nonsense mindset you need for critical phases of flight.*
>
> *Staying ahead of the airplane is another good practice. That way, if something comes up, you'll have more time to assess its impact on safety and determine an appropriate course of action.*

Emergency Practices

Finally, if you think you might be in an emergency situation, this is no time to go it alone. Use the pilot-in-command's authority and declare an emergency. It's always better to explain your actions from a safe place on the ground than to have this become your final flight. A good way to prepare for emergencies is to practice your emergency procedures regularly. Brush up on your short and soft-field takeoffs and landings, as well as your power-off approach and landings. And be sure to practice these maneuvers at your planned mission weight to improve your chances for success should a real emergency occur.

Spatial Disorientation

The FAA's *Pilot's Handbook of Aeronautical Knowledge* contained the following guidance:

> *Under normal flight conditions, when there is a visual reference to the horizon and ground, the sensory system in the inner ear helps to identify the pitch, roll, and yaw movements of the airplane. When visual contact with the horizon is lost, the vestibular system becomes unreliable. Without visual references outside the airplane, there are many situations where combinations of normal motions and forces can create convincing illusions that are difficult to overcome.*

The FAA's *Airplane Flying Handbook* (FAA-H-8083-3) described hazards associated with flying when visual references, such as the ground or horizon, are obscured:

> *The vestibular sense (motion sensing by the inner ear) in particular tends to confuse the pilot. Because of inertia, the sensory areas of the inner ear cannot detect slight changes in the attitude of the airplane, nor can they accurately sense attitude changes that occur at a uniform rate over a period of time. On the other hand, false sensations are often generated; leading the pilot to believe the attitude of the airplane has changed when in fact, it has not. These false sensations result in the pilot experiencing spatial disorientation.*

The FAA's publication "Spatial Disorientation Visual Illusions" (OK-11-1550), stated in part the following:

> *False visual reference illusions may cause you to orient your aircraft in relation to a false horizon; these illusions are caused by flying over a banked cloud, night flying over featureless terrain with ground lights that are indistinguishable from a dark sky with stars, or night flying over a featureless terrain with a clearly defined pattern of ground lights and a dark starless sky.*

The publication provided further guidance on the prevention of spatial disorientation. One of the preventive measures was "when flying at night or in reduced visibility, use and rely on your flight instruments." The publication also stated the following:

If you experience a visual illusion during flight (most pilots do at one time or another), have confidence in your instruments and ignore all conflicting signals your body gives you. Accidents usually happen as a result of a pilot's indecision to rely on the instruments.

The FAA publication “Medical Facts for Pilots” (AM-400-03/1) described several vestibular illusions associated with the operation of aircraft in low-visibility conditions. The somatogravic illusion, which involves the semicircular canals of the vestibular system, was generally placed into the "graveyard spiral" Category. According to the publication text, the graveyard spiral:

“…is associated with a return to level flight following an intentional or unintentional prolonged bank turn. For example, a pilot who enters a banking turn to the left will initially have a sensation of a turn in the same direction. If the left turn continues (~20 seconds or more), the pilot will experience the sensation that the airplane is no longer turning to the left. At this point, if the pilot attempts to level the wings this action will produce a sensation that the airplane is turning and banking in the opposite direction (to the right). If the pilot believes the illusion of a right turn (which can be very compelling), he/she will reenter the original left turn in an attempt to counteract the sensation of a right turn. Unfortunately, while this is happening, the airplane is still turning to the left and losing altitude.”

Useful or Effective Investigation Techniques

Search and Recovery

An alert notice (ALNOT) was issued by the FAA about 2127, and an extensive search was conducted immediately after the accident by the United States Coast Guard (USCG). During the search, portions of airplane wreckage were found floating near and in the vicinity of the last known location of the accident airplane (see Figure 10). The search was officially suspended on December 19, 2022, about 0955. Significant planning was performed to define the search area and establish the water depth and current conditions with input from several state and federal agencies.

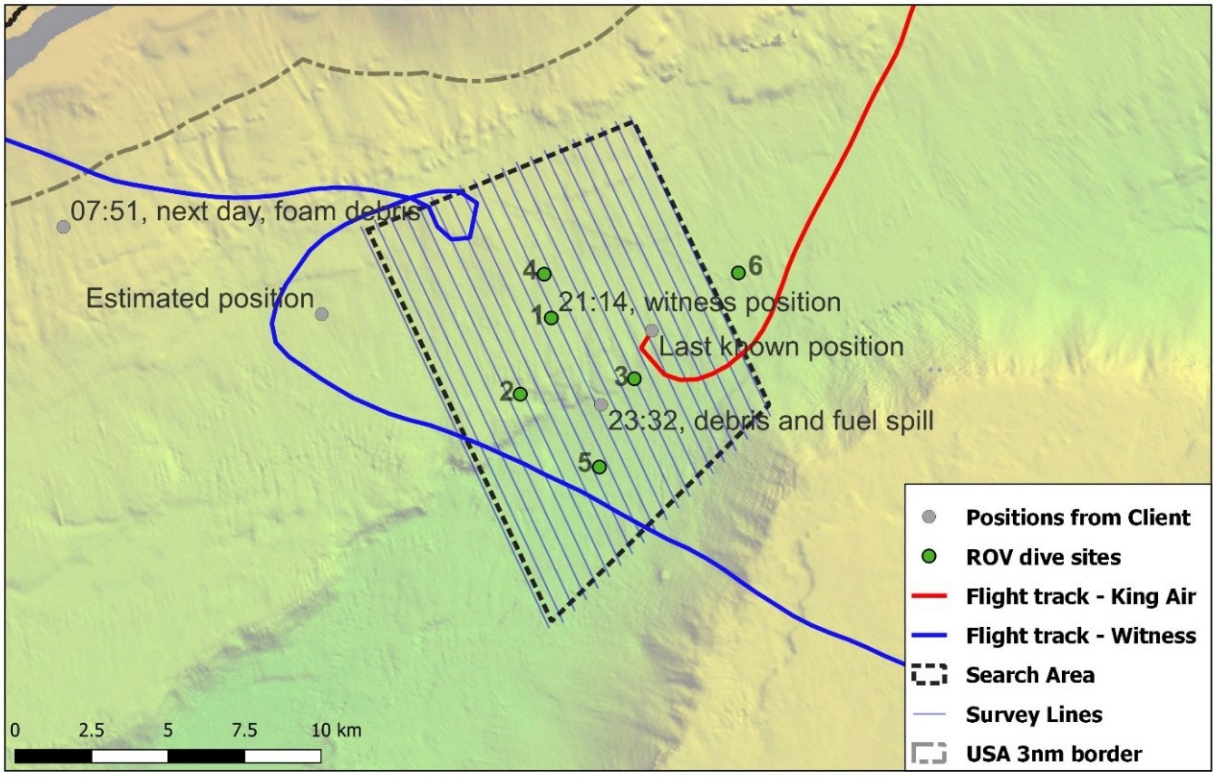

Figure 10. Map of the search grid, and points of interest. (Courtesy of Ocean Infinity)

The recovery was conducted on a highly advanced, multi-functional, offshore survey and salvage vessel, the *M/V Island Pride* (see Figure 11). The vessel was equipped with an ultra-short-baseline (USBL) high precision acoustic position (HiPAP) receiver that was set to listen for emergency beacons.

Figure 11. Ocean Infinity vessel, M/V Island Pride (Courtesy of Ocean Infinity)

The vessel utilized Autonomous Underwater Vehicles (AUV) equipped with a side scan sonar and cameras (see Figure 12). Two AUVs were deployed in a grid pattern near the last known position of the airplane. The sonar imagery from the AUVs was reviewed and 16 points of interest were identified; of those, one was the main wreckage, 2 were the engines and one was a portion of a wing flap.

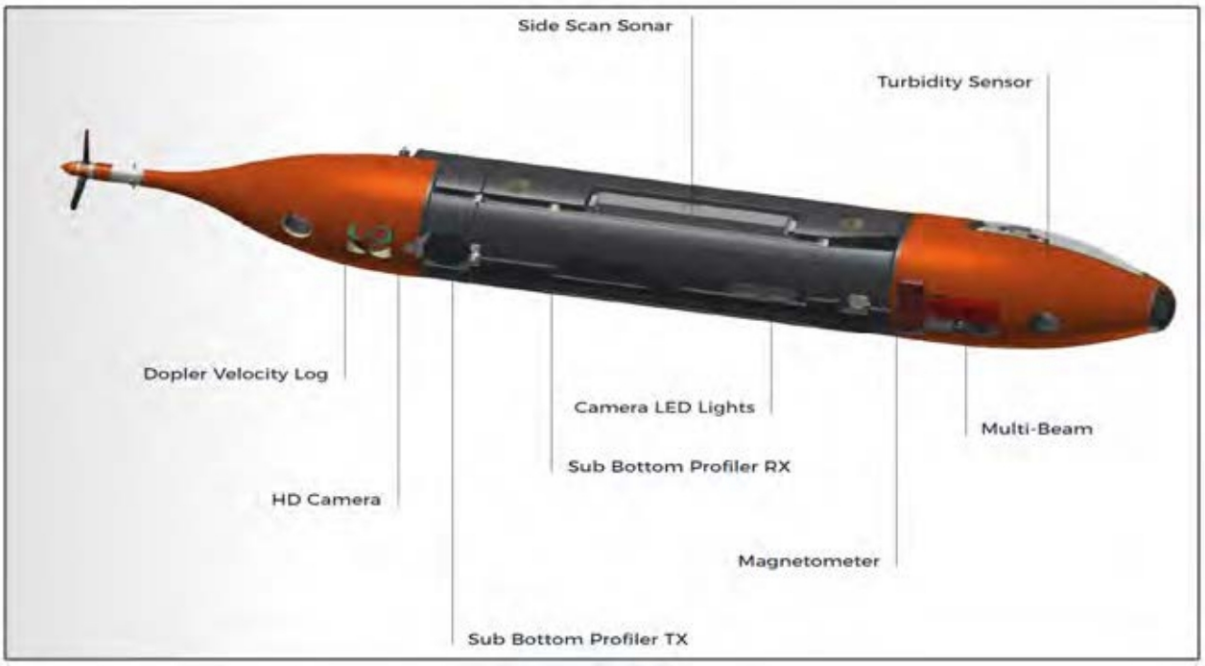

Figure 12. The AUV that was used during recovery efforts. (Courtesy of Ocean Infinity)

A Remotely Operated Vehicle (ROV) equipped with two manipulator arms, cameras, sonar, and a pinger locator was also used in the search (see Figure 13). While the AUVs were completing their survey, the ROV was deployed at six locations near the last known position. During transit around the search area, a strong signal was heard and the ROV located the main wreckage on the seabed at a depth of about 6,420 ft, about 1,181 ft from the last known position. The airplane was laying upside down, with the fuselage largely intact and both inboard wing sections still attached (see Figure 14). The outboard wing sections and empennage were separated and not located. The ROV performed a detailed inspection of the wreckage to assess the structural integrity of the fuselage in preparation for recovery. Lifting straps were rigged around the wreckage and the ship's crane slowly lifted the wreckage to the surface and onto the ship's back deck. The two engines and a wing flap were also recovered.

Figure 13. The ROV that was utilized during the recovery. (Courtesy of Ocean Infinity)

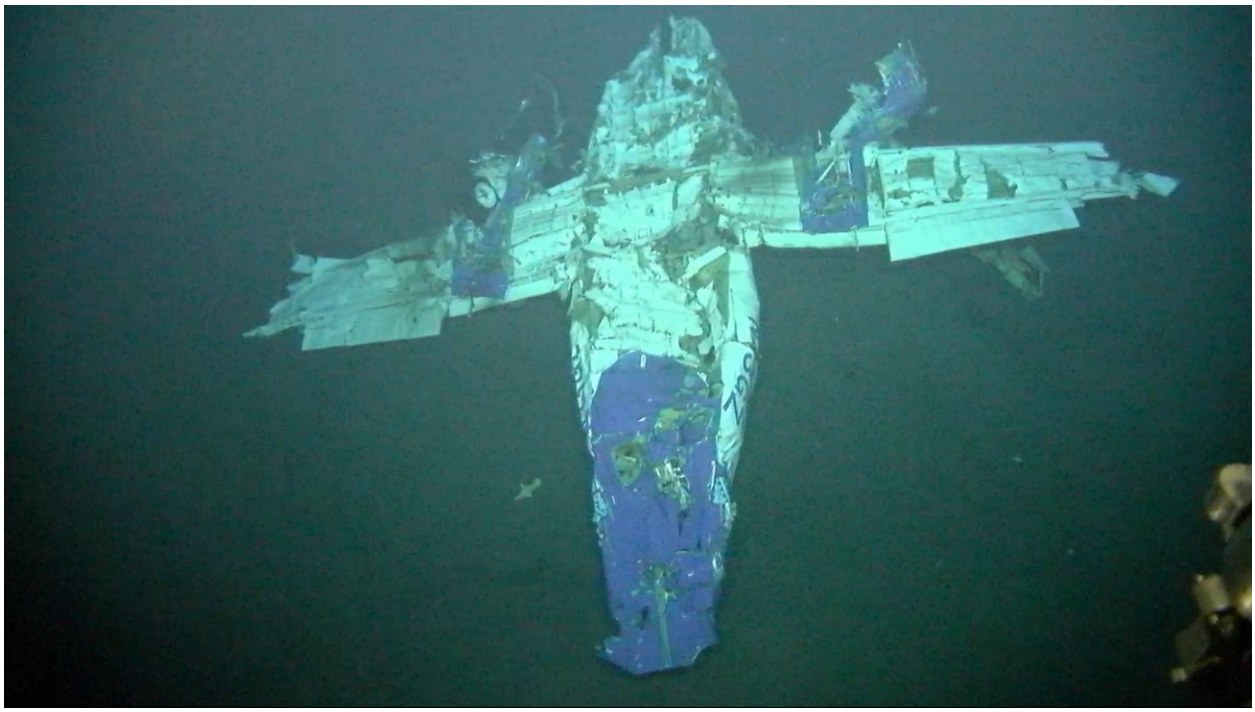

Figure 14. View of N13GZ on the seabed. (Courtesy of Ocean Infinity)

Administrative Information

Investigator In Charge (IIC):	Hill, Millicent
Additional Participating Persons:	Dylan L. Garrison ; Federal Aviation Administration ; Honolulu , HI Michael W. Koenes ; Guardian Flight - Director of Safety ; South Jordan , UT Steve Wilson; Collins Aerospace Ernest Hall; Textron Aviation; Wichita, KS Edwin Miller; FAA/AVP-100; Washington, DC Rob Steel; Pratt & Whitney; British Columbia, OF
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